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OPERATION “CONSTRUCTION”

Mission Objective: Using the materials provided, each group will compete to construct the tallest, most stable, 3 -dimensional structure that can bear the heaviest load suspended from an “s” hook.

Classroom Set-Up: If possible, arrange the room so that students are able to work in groups of 4 at a table. If this is not possible, students may work on the floor or at clustered desk formations.

End Product / Goal: Through the discovery process, students will gain an understanding of fundamental considerations made by architects and engineers when designing / constructing tall, load bearing structures (i.e. skyscrapers).

Suggested Time Frame: Five CCP sessions

Materials / Prep:

* Student “Mission Notebook” (a notebook in which students keep materials related to each mission they embark upon. This notebook should be retained by the CCA leader in a crate or housed in a designated area within the room. Students should be instructed to get their mission notebook when they arrive, and to return it at the end of the session).
* Graph paper & other student handouts (i.e. “data table”)
* Pencils
* 6” wooden dowels ( 24 per team) [**195 dowels total** based on an average of 8 teams / 35 students in the CCA group]
* Gallon Sized Zip Lock bags to keep the dowels in.
* Bags of rubber bands (each team should receive a pre-determined number of rubber bands. 50 is a suggested amount. This amount may change based on what the CCP leader determines is practical).
* “S” hooks ( one per team)
* A hooked brass weight set <http://www.testtubesonline.com/ProductDetails.asp?ProductCode=US%2DWHSET9%2DW>
* Measuring Tapes
* To really motivate the students, invite an “expert” who is an architect or a civil (building) engineer come to your CCP on the planning / building days, and/ or the “testing” day, to talk with and work with the student teams.

Session One: Set the mission. Share with the students that they are going to compete in groups in order to plan / design, and construct the tallest, most stable, 3 -dimensional structure that can bear the heaviest load suspended from an “s” hook.

Form 4 person teams (either student selected, or randomly grouped). Instruct the teams to arrange themselves so they are seated together, and tell them that for the next 4 sessions, they will continue to sit together as a team.

Show the teams samples of the materials that they will be working with, as well as the weights that will be used to test the strength of the structure their team builds. Pass the 500 gram weight around so the students can actually feel what one of the heavier weights feels like.

Distribute graph paper, and inform students that the competition begins today!!! Let them know that they will only have one session to actually build their structure. Today they are to begin brainstorming, and sketching their individual ideas which they will present to their team the next time they meet.

Shortly before the end of the session, direct the students to place their planning materials in their mission notebook, and invite them to keep thinking about what a successful structure might look like. Encourage them to work on their ideas on their own if they wish, and to bring their ideas with them to share with their team at the next CCP session.

Session Two: Planning Day. Direct the students to communicate their ideas with their team, but add that by the end of the session, they must have decided as a team on one idea to go with. Encourage the teams to discuss with one another why they think certain ideas may work best. They may find that they take elements from different sketches to come up with a final plan.

Have a few dowels and rubber bands available for each group to handle. This will give them a chance to get a feel for the building materials.

Session Three: Building Day. Have all materials on the tables for students to begin building with as they come in. As they work, circulate and talk with them about their ideas, what they find is working, and what isn’t. At the end of the session, store the structures in a safe place.

Session Four: Testing Day. Before starting the structure testing trials, ask the students to create a data table. You may find that some students would benefit from a pre-made data table. Instruct the students to record data on their chart for each structure being tested, not just their own. As the whole group as an audience, test each structure. First measure the height of each structure, and then test its strength with the “s” hook and weights starting with the lower weights first and progressively increasing it. If more time is needed for testing structures, the first part of session five will accommodate this.

Session Five: “Sum It All Up”. Complete any testing if needed. Have students analyze the data from their data tables to determine the winner of the challenge. Once the winner is determined, celebrate their success! Present the team members with something tangible (such as a candy bar, ribbon, t-shirt, etc…). Encourage students to discuss with the whole group the successes and failures of their team’s structure. IF they could re-build their structure, what would they do differently, and why??? What have they learned from this activity??

Share the “What Now” information. For example, inform students of S.T.E.M. related career paths that they might follow if this sort of activity really interested them. What kinds of subjects should they take in school?

Operation “Construction” Data Table

|  |  |  |
| --- | --- | --- |
| Team | Structure Height  Measurement | Heaviest Weight Supported |
| Team #1 |  |  |
| Team #2 |  |  |
| Team #3 |  |  |
| Team #4 |  |  |
| Team #5 |  |  |
| Team #6 |  |  |
| Team #7 |  |  |
| Team #8 |  |  |

What NOW?

So, you really liked the Operation “Construction” challenge, huh? So where do you go from here?

Suggested Websites to check out:

* <http://www.bls.gov/k12/build05.htm> ( How to become a civil engineer)
* <http://www.degreefinders.com/education-articles/careers/how-to-become-a-civil-engineer.html>
* <http://www.bls.gov/k12/build04.htm> (How to become an architect)
* <http://www.tryengineering.org/become.php>
* <http://www.careercornerstone.org/pdf/civil/civileng.pdf> ( a great multi page PDF document which can be printed for interested students)
* <http://www.engineergirl.org/>
* <http://www.engineeryourlife.org/>

What classes will I need to take in middle and high school if I want to be an engineer?

|  |  |  |  |
| --- | --- | --- | --- |
|  | http://www.tryengineering.org/become.php    “Students who are interested in pursuing a degree in engineering can prepare for the application process as early as middle school. By selecting a variety of science, mathematics, and engineering-related course work and participating in programs and projects that expose students to engineering concepts, students will have advanced exposure to university level work.”  “While in middle and high school, students interested in engineering should consider taking accelerated courses in several of the following subjects.”   |  |  | | --- | --- | | * Algebra II * Biology * Calculus * Chemistry * Computer Science | * Language Arts * Pre-calculus * Physics * Second Language * Trigonometry | |